## SUMMARY:

## SECUREarth: A Crosscutting Initiative for the Geo-and Environmental Sciences

**SECUREarth's goal is to achieve crosscutting breakthroughs in our understanding of key subsurface processes by accelerating research in geosciences and environmental sciences. This initiative, which is being organized by the community of earth scientists, will integrate research objectives that will enable us to solve our most significant energy and environmental problems.**

### Background

The continued prosperity and security of the United States of America are critically linked to maintaining a balance between adequate and affordable resources and a clean environment. For example, it is widely recognized that we cannot continue forever with our current sources of energy; fossil resources are finite. Although fossil fuels will play a central role in our economy and international policies for at least the next 20 to 30 years, we need to smoothly transition to a nonpetroleum-based economy. And until we do so, use of fossil fuels will continue to stress our environment. Environmental issues are increasing as we place more demands on our energy and water resources. In essence, time is running out to solve our nation's energy supply and environmental concerns.

Although individual subsurface processes are being investigated, progress towards significant solutions—such as increasing hydrocarbon extraction efficiency from the present 35% up to 70%, developing abundant alternative energy sources, providing cost-effective environmental waste cleanup, and protecting our diminishing clean water supply—is unacceptably slow. SECUREarth will accelerate our national scientific research effort, transforming our ability to understand and control complex processes that govern Earth's subsurface environment, and thus our clean water and energy resources. The SECUREarth initiative will develop large, focused research programs designed to provide the critical mass of integrated, multidisciplinary research essential to overcoming the barriers to secure energy and clean water supplies. Although it is important to maintain the distinctiveness of the individual researcher, one of the basic premises of this initiative is integration of our research objectives. It is essential that we facilitate highly coordinated and integrated research, research that focuses on conquering the major crosscutting limitations that prevent the scientific community from making rapid progress in addressing our resource and environmental issues. A key goal of the initiative is developing effective transfer mechanisms for the research results that will lead to technological solutions for practical problems.

SECUREarth, initiated by Lawrence Berkeley National Laboratory and the Idaho National Engineering and Environmental Laboratory, is an outgrowth of discussions within the geosciences and environmental sciences community at workshops and scientific meetings. SECUREarth has received enthusiastic support from academia, the private sector, and many other U.S. national laboratories, and we envision their partnership in this initiative.

### Current Activities and Approach

We are pursuing a long-term, national, multi-agency effort in the geosciences and environmental sciences. We envision that it will be managed by a joint federal-interagency, academic, industrial, and national laboratory working group. An advisory panel, with members from industry, end users, and scientists, has been formed to aid in the initial stages and provide input to the research agenda (see list below). It is important not only that research is linked to end users, but also that end users are participants in the effort to solve these national problems.

SECUREarth will support a critical mass of investigators in carrying out coordinated and integrated multi-disciplinary research, and will focus on solving crosscutting problems whose resolution is fundamental in addressing many energy-supply and environmental issues. The overall thrust of this research effort is to solve urgent problems in the geoscience and environmental programmatic areas supported by federal agency offices, such as the DOE (Office of Science, Fossil Energy, Geothermal, Nuclear Waste Disposal, Environmental Management, Climate Change, $CO_2$

Sequestration), NSF (Geosciences), USGS, NASA, and Homeland Security. Our team approach emphasizes research carried out with:

- Nested observations (i.e., at multiple scales, ranging from nanoscale to field scale) in different representative environments
- Multidisciplinary (fluid flow, geochemical, and biological) studies of coupled, complex, interacting processes
- Integrated theory, measurement, modeling (computational as well as physical), and interpretation
- Manipulation and process-based studies

For example, SECUREarth will build on current work in the DOE Office of Science, such as Nanoscience, Genomics/Genomes To Life (GTL), Natural and Accelerated Bioremediation Research (NABIR), Climate Change, computing, and fundamental environmental science.

Crosscutting research goals will include:

- Quantifying the effect of complexity and heterogeneity
- Understanding scaling from the lab to field scale
- Multiscaled representation of ecosphere parameters and processes

One important crosscutting area for research is the 3-D delineation of fluid behavior in the subsurface. This has been a major roadblock in understanding the geochemical and microbial interactions critical to efficient and cost-effective nuclear waste disposal, energy resource recovery, and environmental remediation.

**Path Forward**

The next step is to define SECUREarth's principal research focus areas. A National Research Council workshop and roundtable was held on July 14–15, 2004 at the National Academy of Sciences in Washington D.C. to solicit DOE, national laboratory, and other applicable industry, federal, and state agencies regarding their needs and expectations for geoscience research. This two-day workshop set the general directions for SECUREarth. For example, we discussed how the initiative should develop working infrastructure, management, and science core teams, such as an interagency coordinating group. In addition, the workshop provided input for setting the crosscutting science themes for follow-on workshops in core areas of research. Periodic updates of the national agencies' science missions will be used to evaluate the direction and composition of the core teams with respect to the national research agenda. Finally, SECUREarth will assist the participating agencies in articulating scientific findings, streamlining research and development needs, and implementing technological solutions where needed. The next step is to generate interest and solicit input from the geoscience community through workshops and town hall meetings. In the fall of 2005, we will hold a two-day workshop (Sept 12–13) at The Colorado School of Mines. The objective is to identify critical crosscutting scientific themes, as well as the technology, to advance understanding in five critical areas (oil and gas, geothermal , nuclear waste disposal, water supply/quality and environmental restoration). The out put is expected to form the basis for the overall science and implementation plan, which will be submitted for review to the National Academy of Science.

**Advisory Panel:**

Dr. Jim Fredrickson, Pacific Northwest National Laboratory
Dr. Susan Landon, Thomasson Partner Associates
Dr. Leon Thomsen, BP America
Prof. Patricia Maurice, University of Notre Dame
Dr. Mark Peters, Los Alamos National Laboratory
Prof. Frank Schwartz, Ohio State University
Dr. Henry Shaw, Lawrence Livermore National Laboratory

urgent solutions to secure earth's future
SECUREarth
Scientific Environmental/Energy Cross-Cutting Underground Research

# A Crosscutting Geosciences and Environmental Sciences Initiative

## Purpose and Needs

The continued prosperity and security of the United States of America is critically linked to maintaining a balance between an adequate and affordable energy supply and a clean environment. In the past 50 years, we have depended heavily upon fossil energy for our main energy supply as well as a base for many of our synthetic materials. Central to our strategy of national defense is nuclear deterrence. Both of these paths have had a dramatic unforeseen impact on our environmental and economic security. For example, if one just considers the legacy of nuclear weapons development, the Department of Energy's (DOE) projected costs for the cleanup of its sites is on the order of $300 to $600 billion. The impact of utilizing fossil energy is tightly linked to our economy and environment. Access to cheap oil continues to shape our international policy. In 2005 each man, woman, and child in the USA will pay an *additional* $434 in energy costs out of a total $1.1 Trillion US energy bill. Global warming is an undisputed fact. Its impact on climate change and the consequences thereof are yet to be seen, but are undeniable. Last but not least, the most valuable resource we have, water, is being taken for granted, yet over a billion people lack access to safe drinking water.

Although we have chosen the above means of energy supply and security with all of its environmental and economic consequences, it is widely recognized that we cannot, and shall not, continue forever along these paths. This is because:

Our resources are finite and, more importantly, time is running out to smoothly transition to a nonfossil-based economy—we cannot transition from a fossil-based economy overnight. Fossil will play a central role in our economic, environmental, and international policies for at least 30 to 50 years, (the energy for hydrogen will have to be a mix of technologies).

Our environmental issues are growing as we place more and more demands on our air and water resources. The current discussions on how to resolve the world energy and environmental issues tend to place more importance on institutional measures, legislative solutions, and dialogue, rather than on scientific understanding and the implementation of technical solutions. This nonscientific emphasis may work in the short run, but this path will ultimately not be acceptable.

Every alternative and/or solution to the above energy and environmental issues will require greatly increased understanding of earth and atmospherics processes and dynamics, to predict and/or manipulate the desired resource. Central to almost all of these processes and dynamics is understanding the behavior, interaction, and impact of fluids in, on, and above the earth, from the nanoscale to the macroscale. For example, bioremediation cannot occur without the presence of bacteria. Almost all bacterial growth, survival, and transport require fluids (either gas or liquid). To optimize the extraction of oil, gas, and/or steam (geothermal resources) from our remaining domestic supplies will require locating (imaging) and manipulating subsurface fluids. Environmental protection will require the withdrawal, injection, and/or manipulation of supercritical fluids ($CO_2$ disposal) and gases (methane); understanding of complex physical, chemical, and bacterial processes; and accurate prediction of transport paths—all dependent on fluid behavior and properties. Safe nuclear waste disposal in the subsurface—an inescapable component of past, present, and future energy generation—is totally dependent on the amount and paths of fluids. Last but not least, the complex fluid mixture we call the atmosphere (including the oceans) is far from being understood, let alone thoroughly predictable in its behavior.

## Research Approach and Components

Although research is being carried out that addresses the above problems, that research is usually in the form of individual projects or groups of projects focusing on an individual aspect of a particular problem. Crosscutting issues and approaches—such as scaling, heterogeneity, imaging, uncertainty—while all common to the problems, are frequently addressed in not only an overlapping manner, but in a duplicative or haphazard fashion. Another problem with the current approach is that research results between individual projects are not shared in any systematic fashion, thus hindering progress in solving major difficulties. Just as serious an issue, however, is how the product of the research or fundamental knowledge is transferred to actually solve a particular problem—i.e., it takes a long time for the basic research results (if ever) to make an impact on solving an actual problem.

Therefore, we believe that due to shrinking resources (time and money) and increasing importance, the geosciences community cannot afford to strictly follow the current mode of research in the fundamental earth and environmental sciences. While there will always be a role for "individual" investigator research, we must have a component of research that is carried out in a more sustained, coordinated, and integrated fashion, research that focuses on the crosscutting critical roadblocks preventing us from making rapid progress in addressing energy-supply and environmental issues.

We therefore propose a multi-year national effort in the geosciences and environmental sciences, managed by the DOE Office of Science, which would support a critical mass of investigators in carrying out coordinated and integrated research. Such research would focus on addressing crosscutting roadblocks whose solution fundamentally addresses energy supply and environmental problems. The research would be closely coordinated with the applied programs in DOE Fossil, Energy Efficiency, Environmental Management, Nuclear Waste Disposal, Climate Change, and other end-use customers. As stated above, the central theme of the research would evolve from a recognition of the roadblocks preventing us from having a more complete understanding of how fluid flow and transport in complex geological environments are affected by the physical, chemical, and biological dynamics in the earth and atmosphere. Participants would be drawn from the U.S. national laboratories, universities, and industry, providing a spectrum of interests and expertise. To transfer the technology as fast and efficiently as possible, the research would be carried out at "application" field sites appropriate for the particular crosscutting research area. Research components would be a coordinated mix of developing theory, lab, field, modeling, processing and interpretation methods, all supported with adequate computational resources. For example, to advance the understanding of subsurface fluid flow and distribution, it is anticipated that one component would be the development of advanced imaging methods. This will not only require a better definition and fundamental understanding of how mechanical and electrical energy couples and interacts with earth materials, but also new measurement technologies (as well as computational methods) to properly analyze and interpret the results (i.e., research in theory coupled with lab and field studies, supported by new measurement methods, adequately modeled—all leading to a final product of adequate imaging of the desired properties.

As stated above, establishing integrated, coordinated, and linked field observations with scaling/integration/process studies, as well as theoretical and modeling efforts over a variety of spatial and temporal scales and in different environments, is necessary for improved understanding, prediction, and manipulation of the ecosphere.

Therefore the key components include:

**A team approach, with emphasis on studies related to critical bottlenecks.** Essential to the success of this entire effort is that the proper teams of researchers be assembled to address several major roadblocks. These would be individuals dedicated to the addressing of their roadblock who can function as a multidisciplinary team and not just as individuals—individuals with a proven track record of working as part of a team, and who have the potential for, or experience of, working between the fundamental and applied research worlds. These researchers would work together on the problem, each focusing on different components of the problem but at the same site (i.e., from characterization through process studies through modeling/validation).

**Nested (i.e., multiple-scale) observatories in different (representative) environments.** To address crosscutting issues such as scaling and heterogeneity, common measurements at different scales (from the nano to the macro) must be carried out. Dedicated sites of studies would be established at sites that are well validated and can support multiscale studies. No one site will meet all needs, but it is anticipated that a multitude of sites will not be necessary.

**Integrated theory, measurement, modeling, and interpretation studies**. Many different modeling approaches have been developed, ranging from deterministic to stochastic, and from data driven to physics based. Model choices are often made based on investigator background and data availability. Modeling research should continue, but with more emphasis given to uncertainty assessment, improved parameterization, and data assimilation approaches, standardized validation procedures, improved frameworks for incorporating indirect data (tracers, geophysics, remote sensing, etc.) and improved numerical representation of coupled processes (such as hydrogeological-biogeochemical) and systems (such as land and atmosphere). Before measurements (particularly in the field), modeling should be carried out to not only predict results but design measurements.

**Manipulations**. Use manipulation experiments to (1) test the validity of integration/scaling/process study/theory/modeling efficacy and (2) start to gain an understanding of the potential in manipulation experiments for improved and sustainable ecosphere management and development.

**Process studies**. Incomplete understanding of fundamental processes greatly handicaps our efforts to guide resource planning, to predict hydrologic extremes, and to predict contaminant migration. For example, in the subsurface, some of the key knowledge gaps include: lack of understanding of the interactions between biogeochemical-hydrological processes over various length and time scales; lack of understanding and of flow and transport of water and contaminants through the vadose zone and within fractures; lack of understanding about fluxes across interfaces, such as across the vadose-groundwater and land-air boundaries.

## Path Forward

An immediate first step is to assemble a core group of experts and leaders in the geoscience community to identify the research necessary to overcome the critical roadblocks (see examples below) preventing us from solving the crosscutting problems in the various areas of interest. This is planned to be accomplished through a series of workshops over the next 9 to 12 months. At that point, an overall technical plan and business model will be developed for the effort. A coordinating committee will then be formed and a “proposal” will be written to accomplish the goals laid out. It is envisioned that this will be accomplished in two 5-year phases, iterating between basic/fundamental research and applications at research sites specific to particular DOE needs.

# Appendix II Examples of Crosscutting Research Areas and Critical Roadblocks

### I. Behavior of multiphased fluids in heterogeneous media

Fundamental to the efficient and safe extraction and injection of fluids into the subsurface is accurate prediction of not only fluid phase and content, but also the knowledge of flow paths, permeability, and the interaction among the physical, chemical, and microbial processes and properties. Current capabilities severely limit our ability to cheaply and efficiently predict the location of contaminants, accurately predict the location of energy and water resources, store and or dispose of fluids ($CO_2$, gas storage, etc.) predict fluid movement, and remediate the subsurface.

Roadblock: Prediction and monitoring of fluid flow and content

Subroadblocks: adequate characterization of flow paths, mapping fluid content and type, complete knowledge of coupled reactions

Research needs: improved imaging, adequate understanding of energy coupling, partitioning and transfer with earth materials filled with multi-phased fluids, adequate understanding of coupled physical and chemical effects with external force (pressure, thermal, electrical, mechanical) in multi-phased media. Constitutive equations for general coupled solution of anisotropic, porous multi-phased media. Accurate understanding of interactions of the matrix properties with fractures in a multi-phase fluid. Coupled inverse methods. Broadband sources and receivers of electrical and mechanical energy. Accurate information of geomechanical properties and processes. Investigation of the hierarchy of processes at the grain-boundary scale to the field scale.

## II. Multi-scaled representation of ecosphere parameters and processes

The key bottlenecks associated with this impediment include:

Investigation of dominant processes and interactions between processes that occur at different spatial scales, and reconciling the different spatial scales associated with measurements, physical processes, and numerical models. We do not understand how to use data collected at one scale for process prediction at another scale, and we do not know how to recognize a-priori what are the critical time and length scales at which to investigate the ecosphere.

Data integration approaches. Various data sets, such as tracers, ground-based geophysics, and remote sensing are becoming increasingly available for use in ecosphere studies. More research is needed to fully develop the potential that these tools have for assisting with our geoscience initiative. With these data sets, we should strive to move beyond site-specific inference, based on spatial patterns, toward an improved understanding of the physics, so that the data can be used to more generally and quantitatively estimate hydrological-climatological parameters of interest. A better understanding of data integration approaches are needed to enable routine calibration or to facilitate a comprehensive interpretation. Full joint inversion techniques, which incorporate and capitalize on information from co-located data sets, should be attempted (rather than sequential or iterative inversion approaches, as is currently performed). For example, it is intuitive and obvious that geophysical inversion can and should benefit from hydrogeological constraints. Uncertainty in the final information set—associated with data acquisition, data processing, parameter estimation, and data set integration—should be rigorously addressed so that these uncertainties can follow through to the process prediction phase of the investigation.

Although these are only a few of the major roadblocks, one can see that by addressing the problem at the most fundamental level, we will be able to make significant advances in shorter time frames than we are now. The challenge is to break each roadblock into manageable pieces of work, but coordinate the work such that the work products all feed into successful results.

# Minutes of the Meeting of Opportunity on the SECUREarth Initiative

# July 14–15, 2004.

**National Research Council**

**Board on Earth Sciences and Resources, and**

**Board on Radioactive Waste Management**

## Summary of First Day (see attached agenda), July 14, 2004

In our opinion, the entire meeting was a success. Pat Dehmer was very supportive in opening the meeting for Ray Orabach and challenged the group to think broadly. She indicated that OS would be interested in a "decadal study" by NRC/NAS. The other speakers all addressed the questions (see agenda) and were supportive of the research goals.

In the discussion sessions, all agreed that the devil was in the details, a focused science and implementation plan must be developed that meets the goals of SE. It was clear that we must be able to lay out our science drivers and build upon current ongoing research in the geosciences, as well as take advantage of various other current scientific programs and facilities. *The two main themes that emerged were, "Diverse problems have similar solutions," while addressing the common thread in our quest to study subsurface flow—"isolate or produce."*

On the second day, various options were discussed as to how, when, and what type of study could proceed. One option was to turn it over to the NRC 100% and let them develop a science plan and societal impact study. A second option would be for the geosciences community to develop the plan and impact, then turn it over to the NRC for review. In either case, the time would be the same, as well as the cost.

Currently, we are leaning towards the latter option. Our tentative path forward is to convene a focused workshop in the fall of 2005 time frame with participants from universities, industry, and labs to draft a science plan. After modifications were made, it would be turned over to NRC for a review, starting next summer.

In parallel to the plan development, we will be presenting the SE concept and status at various professional meetings to inform and hopefully obtain grassroots support for the SE initiative (for example, we have a "town hall meeting" scheduled for GSA in November 2004, AGU in Dec. 2004, and other similar opportunities)

In the discussion sessions, all agreed that a *focused science plan* must be developed that meets the goals of the SECUREarth initiative.

- Possible crosscutting focus areas include:
    - Heterogeneity
    - Scaling
    - Imaging
    - Coupled processes

- To be effective in addressing the broad range of subsurface environmental and energy problems, our science plan must be based on crosscutting research themes. The concept “Diverse problems have similar solutions” underlies our crosscutting themes.

- We must reinforce the common thread in our quest to study subsurface science: “understanding flow”—we are trying to “isolate or produce” subsurface fluids.

Discussions emphasized the need to improve the study of the subsurface environment necessary to protect and manage our natural resources. Technically we must develop better science understanding before solutions can be implemented, and we must develop better ways to make measurements, image, characterize and monitor subsurface properties and processes. Reliable predictive models and technology to effectively manipulate subsurface processes are long-term goals of the environmental and energy community.

## Second Day Summary of the NRC Panel Meeting

Attendees:

**NRC Panel**

George Hornberger, Chairman, University of Virginia

Susan Landon, Thomasson Partner Associates

Diane McKnight, University of Colorado

Don Steeples, University of Kansas

Alan Stone, John Hopkins University

John Wilson, New Mexico Tech

**Sponsors**

Bo Bodvarsson, LBNL

Ernest Majer, LBNL

Russ Hertzog, INL

Rick Colwell, INL

**Others**

Mike Graham, INEEL

Wendy Harrison, CSM

**July 15, 2004**

SECUREarth Day 2

The purpose of the second day was to discuss various paths forward in implementing a NRC study that could be undertaken, in the light of the first day results.

**Key themes summarized from SECUREarth presentation on Day 1:**

- Diverse problems have similar solutions
- 2 aspects—Isolation or production

**Options for NRC reports:**

1. NAS formulates and delivers a science plan (NAS panel deliver a science plan with input from sponsors)

2. SECUREarth formulates and delivers a science plan to NRC with an implementation strategy (NAS panel review a plan developed by sponsors)

3. Iterative process—review plan along the way; workshop report; NRC review of report; final plan. Need info on similar iterative process: for example, CCSP—time, cost, committee.

## Next Step for an NRC Report

- Roundtable of sponsors to discuss a *Statement of Task*

**Potential Funders**: (if multi-agency approach)

- DOE, NSF, USGS, DOD, USDA, EPA

## Next Steps for SECUREarth Initiative

- Currently planned workshops possibly linked to SE
    - RWSC workshop on vadose zone processes
    - Computational needs in subsurface science
- SE conduct workshops with labs, industry, and universities to focus ideas. Fifty to 100 people from labs, university, and industry; produce white paper or summary that would be basis for work scope
    - Lay out issues, identify barriers
    - What are important questions to address problems and can they apply to 2–3 or more areas (diverse problems with similar solutions)? If we addressed these problems, would they make a significant impact?
    - Define examples with multidisciplinary aspects to illustrate philosophy in solving components
- Define a grassroots effort—GSA and AGU (SEG) this fall—use meetings to build community; layout framework and let science community contribute ideas on science
- Provide information for decision makers to make more informed decisions about resources use

In a post-meeting discussion, John Wilson and Rien van Genuchten recommended using the Vadose Zone Roadmap (modified to include saturated media) as a good start for a preliminary SECUREarth science plan.

## Concerns brought up the second day

- Will SECUREarth divert money away from present programs? (On the other hand, we must have initiatives in the pipeline to keep current funding up)
- How will the process of forming and implementing SECUREarth be kept on a level playing field?
- The name sounds too much like homeland security
- How are we going to keep it from ending up like the Vadose Zone Initiative (i.e., never implemented)?

## Discussion points on the possible scope of the SECUREarth initiative

- Pat Dehmer spoke about two things—SECUREarth in long term and decadal study for BESR
- Nick Woodward suggested that the scope could be expanded (i.e., surface boundary conditions)
- Original conception of SECUREarth—change way of doing things in Earth sciences
- Reactive transport—originally transport on one side and chemistry on other
- Need to identify common (cross-cutting) thread or thrust (e.g., flow delineation)
- Found that there was a unique interaction between transport and chemical, and that they could not be studied independently—coupled processes
- Can't divorce from biology, chemistry, math, etc. Get this idea in the title/logo
- Need more partners to clarify objectives
- Elevator speech—how will world be different if we do/don't get this money (Note: getting the elevator speech is the easy part, putting together a good science plan is the hard part)
- Fluids and earthquake prediction? Note: revelations occurring at faults and fluid flow
- Study and understanding pore structures—this relates to all kinds of science and process
- Consider recommendations from "Seeing Into the Earth" (note: Seeing Into the Earth, NRC, 2000, evaluates state of art—it is not a visionary document)
- Do we know who is doing what and where?
- Nick Woodward has a good chart for a review of within federal agencies; also DOD is doing things that we don't know about
- Biogeochemistry—lots of exciting new potential for research and science
- Foster collaboration across the disciplines and improve what we understand that way
- Vadose Zone Roadmap—disappointed that little came out of that
- Formation evaluation—combine different methods to get measurements

## We need to articulate new and compelling science

- What are the science questions?
  - Delineation of flow—3D flow
  - Geochemical manipulation and flow
  - Biochemical manipulation and flow
  - Geo/Biochemical reactions to clean subsurface

**Discussion points on Should SECUREarth—Be a single or multi-agency initiative?**

- How will we structure from institutional side—multi-agency or single agency (DOE)?
- Multi-agency is a "natural fit" because problems are broad and not likely to be taken up by any one agency
- OMB might not "buy-in" if not a multi-agency initiative
- Multi-agencies provide stability

**Discussion points on how do we form the consortium, and structure the program in such a way that we get it funded**

- Grassroots effort (bottom up) and/or a top down approach?
- What part does the NAS play in this process?
- DOE shifting to problem solving approach
- Workshops to get buy in from the community, vision, we need a sexy title (i.e. Genomes to Life)
- Problems with pulling together infrastructure for a new plan—Funding, new science, science versus technology, architecture, etc.
- There are model examples of successful programs (GENOMES to Life, Vadose Zone, Water Cycle Science Plan, Carbon Cycle, Earth Scope)
  - How have their plans evolved?
  - What are their steps?
  - What do we need to do for SECUREarth?
- A working process: solicit input, professional meetings, write to people, put info in EOS, workshops
- Astronomers—put together NRC panel and every 10 years they go out and identity best ideas, build consensus; good way to bring best ideas to the table
- Use NRC to build foundation for set of champions
- Arrange things according to concept instead of application?
- Coupling with biosciences is a new hook
- Is new money possible because DOE office of science has been left behind?

**Discussion points on Science versus Technology Focus**

- Comment was made that nobody articulated any new science questions
  - Gary Jacobs (on Day 1) suggested that we turn this around. Admit that the questions are more or less the same, but (with new technologies) we are on the verge to take a new approach—the SECUREarth approach
- SECUREarth white paper
  - Here are the challenges
  - Here are the changes (technologies)
  - Here is how we will go ahead
- Heavy technology oriented?
- Program focused on science that produces new understanding or will it focus on technology (science or science and technology program?); new concepts or new tools (*We need to consider—APPROPRIATE BALANCE BETWEEN SCIENCE AND TECHNOLOGY*)
- Issues--Biogeochemistry and biogeophysics
- Adv of big field programs—most valuable when they tell you something that you don't know before
- Real problems with common subsurface underpinnings, but effort has been fragmented, leading to incremental developments
- Need a shift in how we do business—what is the fundamental difference that makes this different? *Answer:* fundamental difference is a different approach to attaching problems—no single PI; attack as a problem from multidisciplinary approach and bring in need expertise
- How do geosciences help address problems?
- Focused science on the solution of a problem
  - Science driven understanding of the problem
  - Science principles used to develop technical solution
  - Technology and implementation need to be user focused
- Equal opportunity for all partners (national labs, academics, and industry scientists)
- Money issue? Brought in a new appropriation for Genomes to Life so our vision is new money
- Campaign-type science (case study)—theme and architecture for oversight

**MEETING OF OPPORTUNITY ON THE SECUREARTH INITIATIVE**

Board on Earth Sciences and Resources and the Board on Radioactive Waste Management

National Research Council

2101 Constitution Ave., NW

Washington, D.C.

Tel. 202-334-2744

July 14-15, 2004

# AGENDA

**Wednesday, July 14 , 2004**
National Academies Main Building, Lecture Room

| | | |
|---|---|---|
| 7:30 a.m. | Continental breakfast available in the meeting room | |
| 8:00 a.m. | Welcome and Introductions | *George Hornberger*<br>*Committee Chair* |
| 8:05 a.m. | Opening Remarks | Pat Dehmer for *Ray Orbach, Director of Office of Science*<br>*US Department of Energy* |
| 8:20 a.m. | Overview of SECUREarth Initiative | *Bo Bodvarsson, Earth Sciences Division*<br>*Director, LBNL, and*<br>*Russ Hertzog, Subsurface Science Initiative Director, INEEL* |
| 9:00 a.m. | Federal Agency and Industry Needs<br>*(5-8 minute presentations)* | |

Speaker Questions:

1. What are the key geoscience problems your agency/company is addressing? (Or, what is the role of geoscience research in your environment?)

2. Are there cross-cutting research issues that would benefit from common research goals (For example, how would improvements in "seeing into the earth" help your problems/issues?)

3. Would your agency/company benefit from a national research program to develop relevant science and technology implementation (such as the SECUREarth Initiative)?

*Margaret Chu, Director, Office of Civilian Radioactive Waste Management, DOE*

*Edith Allison, Program Manager Exploration, Office of Fossil Energy, DOE*

*Mike Wright, Retired, INEEL Subsurface Science Initiative Director*

*Pat Leahy, Associate Director for Geology, USGS*

*Rien van Genuchten, Former Research Leader, Soil Physics and Pesticide Research Unit,Agricultural Research Service, USDA*

*James Woolford, Head, Federal Facilities Restoration and Reuse Office, EPA*

*Margaret Leinen, Assistant Director of Geosciences, NSF*

*Caroline Purdy, Acting Director, Office of National Labs, DHS*

*Jeffrey Marqusee, Strategic Environmental Research and Development Program, Environmental Security Technology Certification Program, DOD*

*Noel Scrivner, DuPont Fellow, DuPont Engineering Research and Technology*

*Barry Katz, Fellow, ChevronTexaco*

*Richard Coates, Research Program Manager, Schlumberger*

*Mark Gilbertson, DOE EM*

| | | |
|---|---|---|
| 10:45 a.m. | Break | |
| 11:00 a.m. | Roundtable Discussion on Cross-cutting Issues | |
| 12:15 p.m. | Lunch | |
| 1:15 p.m. | Focused Science Presentations | |
| 1:15 p.m. | It Was Not a Lack of Stones That Ended the Stone Age | *Fred Hoffman,*<br>*Vice President,*<br>*Exploration & Deepwater,*<br>*Shell International Exploration and Production Inc.* |
| 1:45 p.m. | Organizing for Innovation in Geoscience Research | *Franklin W. Schwartz,*<br>*Ohio Eminent Scholar in Hydrogeology,*<br>*The Ohio State University* |
| 2:15 p.m. | Elements of Successful Geoscience Research | *Frederick Colwell,*<br>*Researcher, INEEL, and*<br>*Ernest Majer,*<br>*Scientist/Division Deputy Director, LBNL* |
| 2:45 p.m. | Break | |
| 3:00 p.m. | Discussion on Research Issues | |
| 4:15 p.m. | Wrap-up and Discussion of Next Steps | *George Hornberger*<br>*Committee Chair* |
| 4:30 p.m. | Adjourn | |

* *Denotes invited speakers*

****PLEASE NOTE: NRC PANEL MEMERS AND SPONSORS ONLY**

**TO MEET ON JULY 15th**

**NRC Panel members:**

George Hornberger, *Chair*, University of Virginia

Susan Landon, Thomasson Partner Associates

Diane McKnight, University of Colorado

Don Steeples, University of Kansas

Alan Stone, Johns Hopkins University

John Wilson, New Mexico Tech

**Thursday, July 15, 2004**
National Academies Main Building, Board Room

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| 8:00 a.m. | Continental breakfast available in the meeting room | |
| 8:30 a.m. | Overview of the NRC process | *Anthony de Souza*<br>*Director, Board on Earth Sciences and Resources* |
| 9:00 a.m. | Overview of key issues from previous day's presentation and discussions | *George Hornberger to lead discussion* |
| 10:15 a.m. | Break | |
| 10:30 a.m. | Discussion on potential study topics and funders | |
| 12:00 p.m. | Lunch | |
| 1:00 p.m. | Breakout groups to refine statement of task | |
| 2:00 p.m. | Recap and next steps | |
| 3:00 p.m. | Adjourn | |